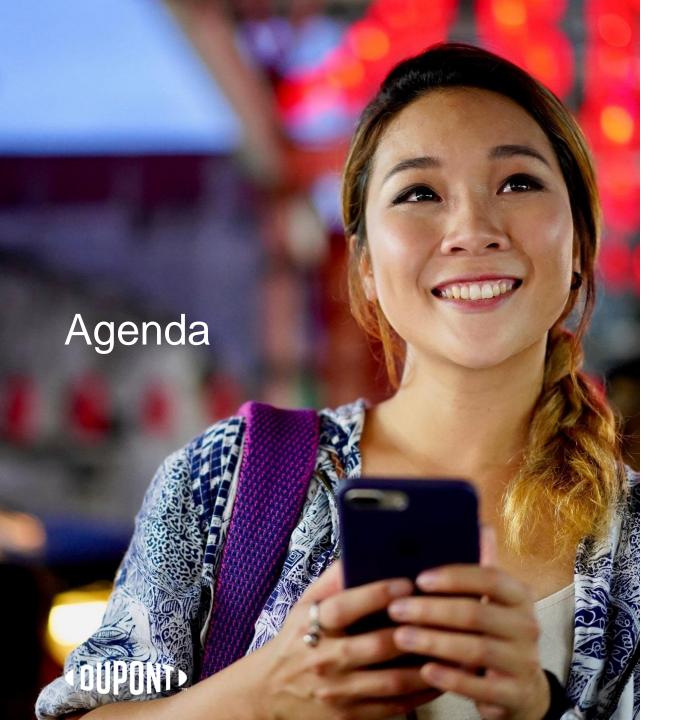
DCOI's favorable environmental profile during treatment and in-service use

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- Isothiazolinone chemistries
- DCOI proven track record
- Environmental Performance
- Summary and Conclusion

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Dichloro-octyl-isothiazolinone (DCOI)

 4,5-Dichloro-2-octylisothiazol-3(2H)-one (DCOI)

CAS: 64359-81-5

- Broad-spectrum antimicrobial activity
 - includes fungi, algae & bacteria



DCOI: enduring regulatory performance

Approved for use under US EPA and EU Biocidal Products Regulation (EC)528/2012

US EPA: Active substance first approved in 1983

EU BPR Approved as wood preservative in 2008

(national approvals in EU countries since late 1990's)

Wide range of uses:

Wood preservation

Marine antifouling. US Presidential Green Chemistry Award in 1996

Cooling tower: algaecide

Paints and coatings: control of mold and mildew.





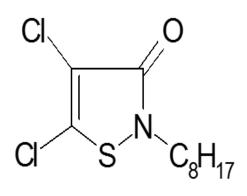








Dichloro-octyl-isothiazolinone (DCOI)



• EFFECTIVE PERFORMANCE- DOES THE JOB:

Broad spectrum activity; extremely low leaching:

RAPIDLY ELIMINATED- GOES AWAY:

- Quickly biodegraded (not "persistent")
- Easily detoxified (ring-opening) and biodegradable

LEAVES NO SIGNIFICANT ENVIRONMENTAL IMPACT

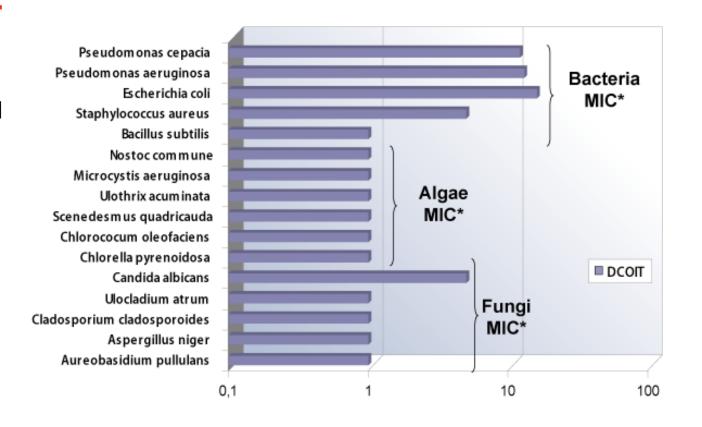
- Not bioaccumulating
- Not a "priority substance" for water policies
- Low mobility in soil and effective mineralisation



DCOI: environmentally sustainable performance

Performance and Endurance:

- Non-metals-based organic chemistry
- Broad-spectrum: algaecide fungicide and bactericide, long lasting performance
- very low water solubility (<5 ppm)
- low leaching, high substantivity
- UV-stable
- Low volatility from treatment systems or in use
- System Compatibility





DCOI: Environmental profile in soil

- Biodegrades quickly in soil and dissipates through removal mechanisms
- DCOI demonstrates degradation half-lives in soil between 12 and 48h @ 42-77 deg F*.
 Dissipation, consisting of primary degradation, adsorption of non-extractable breakdown products to organic matter and subsequent mineralization, was characterised with a half life under 5 days.
- Soil mobility: Organic carbon/water adsorption coefficient (Kaoc) is high (mean Kaoc = 6600), indicating that (DCOI and) degradates bind strongly to soil and sediment. Mobility and transport into environmental waters is consequently very low, with corresponding low risk of groundwater contamination.
- Incorporation into humic fraction and ultimate mineralization occurs at natural rates. Dioxins, furans were not detected.
- *Results of simulation studies. Ready biodegradability studies are not suited to many biocidal actives



DCOI: Environmental profile in water/sediment systems

- DCOI biodegrades very quickly in water and dissipates through removal mechanisms into sediment
- DCOI biodegradation half lives in fresh and estuarine water are from 3 hours to 1.5 days.
 In studies, parent compound despite rapid partitioning, was not detected in sediment.
 Dissipation from environmental water/sediment systems is by primary degradation and subsequent absorption and mineralization of breakdown products
- Groundwater contamination risk is considered negligible due to
 - Rapid partitioning to soil/sediment and irreversible binding to solid matter
 - Degradation, lower inherent toxicity of breakdown products, mineralization
- The Bioconcentration Factor (BCF) is assessed as low: does not bioaccumulate
- DCOI at high dilution will behave similarly in wastewater treatment facilities



DCOI Biodegradates

Biological process (reactivity at the Sulphur-Nitrogen bond and cleavage of the isothiazolinone ring)
 drives the degradation process. Critical degradates characterized

N-(n-octyl) malonamic acid (NNOMA)

N-(n-octyl) acetamide (NNOA)

N-(n-octyl) oxamic acid (NNOOA)

2-chloro-2-(n-octyl carbamoyl)-1-ethene sulfonic acid

- Lower orders of magnitude of toxicity (2-5X) than parent. Toxicity to earthworms in DCOI treated soil systems shows environmental concentrations of no concern.
- Both NNOMA, NNOA are readily biodegradable. In addition structural activity relationship (SAR)
 assessment) predicts NNOOA and the sulfonic acid breakdown product will similarly biodegrade.
- Simulation studies demonstrate that degradates are tightly bound to soil/sediment
 - Non-mobile, do not migrate
 - Full mineralization occurs at natural rates: incorporation into humic fraction



Key Benefits

- Global approvals
- Highly effective, extended performance broad-spectrum preservative
- Organic molecule non-metal-based; Rapid degradation in biotic systems
- Effective and non-extractable binding reduces bioavailability and environmental toxicity
- Breakdown products lower toxicity and removed through mineralization
- Non-persistent no water framework priority; non bio-accumulative in the food chain
- Absence of systemic toxicity; no dioxin generation
- Dilute concentrations removed through Wastewater treatment plants



DCOI: today's choice for environmentally sustainable wood preservation

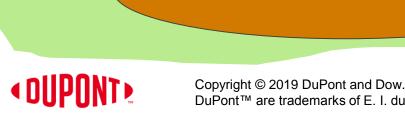


Strong binding of degradates, natural mineralization

Low leaching to soil; rapid primary

degradation

DCOI: today's choice for environmentally sustainable wood preservation



Strong binding of degradates, natural mineralization

Low mobility removes risk of groundwater contamination

Low leaching to soil; rapid primary

degradation

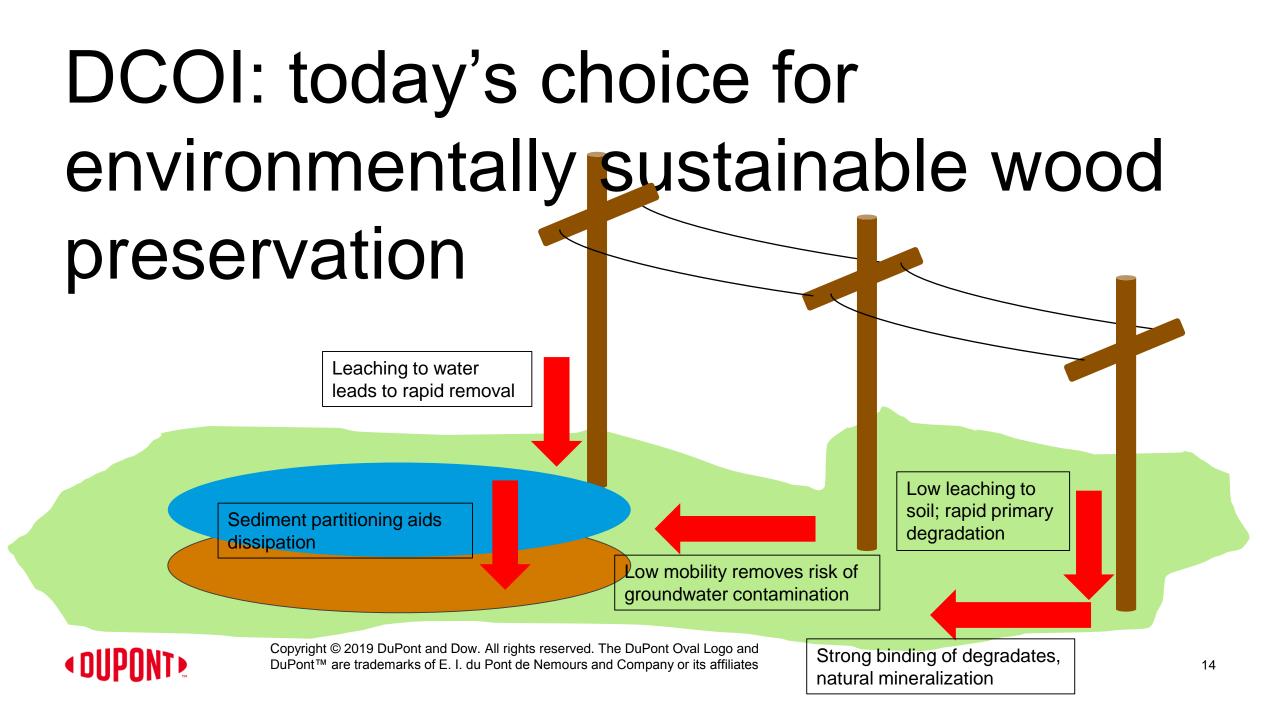
DCOI: today's choice for environmentally sustainable wood preservation

Sediment partitioning aids dissipation

Leaching to water

leads to rapid removal





Thank you for your attention



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